

Cooperative Research Center in Coatings

Eastern Michigan University (EMU), Michigan Molecular Institute (MMI), and North Dakota State University (NDSU)

An improved understanding of coatings leads to innovative approaches to coatings-related problems

Center Mission and Rationale

The Center's two-fold mission is to be a leading academic organization that develops relevant scientific knowledge for understanding and expanding the technology of paints and coatings for the benefit of its members and to enlarge the cadre of scientists and technologists capable of working effectively with coatings.

Coatings are important in most sectors of the U.S. economy, and there are many opportunities for substantial technological impact. This Center brings together three institutions with highly complementary capabilities to work in this area. The EMU faculty is strong in synthetic chemistry and crosslinking of polymers and in the formulation, application, and testing of coatings. MMI's faculty is strong in polymer synthesis, polymer physics, rheology, colloid chemistry, and theoretical treatment of complex polymer systems. The NDSU program has exceptional strength in three areas: vibrational spectroscopy of surfaces, anticorrosion coatings, and water-borne coatings.

Research Program

The Center started operation in 1995. Its research

thrust areas are defined by critical problems facing the coatings industry and coatings users —

- Reduction and, ultimately, elimination of air pollution derived from coatings
- Cost-effective improvement of product quality
- Improved corrosion protection.

The Center performs precompetitive research in eight areas of science and engineering that are directly relevant to these thrust areas —

- Cross-linking chemistry and cross-linked film properties
- Low-solids and solventless coatings
- Testing and analysis of coatings
- Stabilization and rheology of dispersions and coatings
- Scanning probe microscopy of coatings
- Corrosion protection by coatings
- Adhesion of coatings, especially adhesion to plastics
- Surface and interfacial spectroscopy.

Projects are implemented primarily by faculty, staff, and students of the three institutions. Resources of the institutions are combined to focus multiple skills on important problems. Project selection and implementa-

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Dr. D. Meier and Dr. F. Lin discuss the topography of coatings that have been imaged using a TopoMetrix Atomic Force Microscope at MMI. AFM images of various surfaces are shown on the back wall.



Anneke Kaminski, a graduate student at NDSU, operating a Fourier Transform step-scan Infrared Spectrometer.

tion is guided by the Center's Industrial Advisory Board, which meets twice a year. Each Center member company or organization has one vote on this Board. At its inception the Center had 17 member companies and organizations and a total budget of about \$700,000/year.

Examples of specific research projects are:

- Use of vibrational spectroscopy and atomic force microscopy to study polymer surfaces and the effects of surface treatments
- Collaboration of polymer synthesis chemists and rheologists to devise solvent-free, water-reducible industrial coatings with good film properties
- Pathbreaking physical studies of film formation in latex paints
- Development of electrochemical noise analysis to test the ability of coatings to protect against corrosion in hours, rather

than the years required by field tests

- Development of more accurate methods to analyze water in paints (a critical industry problem) by chromatography and by near-infrared spectroscopy.

Special Center Activities

The Center is an outgrowth of a similar, but smaller, Center in operation at EMU and MMI from 1990 to 1995. Tangible accomplishments of the former Center included:

- Thirty-five publications, with more in the pipeline
- Three patent applications, of which one has issued, one has been allowed, and one is pending
- Education of students who, upon graduation, are highly sought after by the coatings industry.

Perhaps the most important accomplishment is that member companies reported starting

seven substantial projects to follow up on Center research. Many smaller interactions took place among member company personnel and Center investigators.

Capabilities and Facilities

EMU and NDSU are two of the largest academic programs in the United States featuring the science and technology of polymeric coatings. MMI is a leading center of research in polymers. Together they bring unequalled resources to the study of coatings. For example, NDSU is in the process of adding \$200,000 of new FT-IR and FT-Raman instrumentation to its well-equipped vibrational spectroscopy laboratory; and it has unique capabilities in corrosion testing. MMI established an atomic force microscopy facility in 1992 and has upgraded its equipment and expertise for investigation of coating surfaces since then; pathbreaking applications in the study of latex film formation have already been demonstrated, and extension to study of other coatings problems is planned. EMU has strong expertise in the synthesis, crosslinking, study, and evaluation of coatings polymers, supported by up-to-date equipment such as oscillating DSC, NMR, microscopic FT-IR, and chromatographic equipment.

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Mark Hedstrom analyzing coatings samples with a Gas Chromatograph/Mass Spectrometer, equipped with an automated head space sampler, at EMU.